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(54) **Apparatus and method for printing borderless print image**

(57) A borderless printer (10) having a print zone (18) includes a platen (30) having an opening defined by a set of upstanding wall members (34) that terminate in a lip (36). A front set of cockle ribs (35) and a rear set of cockle ribs (37) extend upwardly from said lip (36) for supporting from below a medium sheet (16) as it passes over said platen (30). A block of ink absorbent member (40) is disposed below the lip (36) and within the platen opening for absorbing an over the edge ejection of ink droplets directed at the peripheral edge of the medium sheet (16) as it passes through the print zone (18) to facilitate the formation of a borderless print.

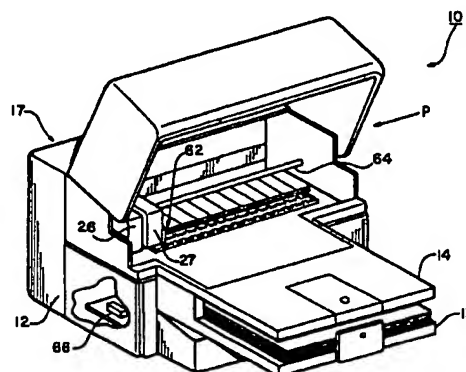


FIG. 1

Description**Technical Field**

- 5 [0001] The present invention relates in general to a method and apparatus for printing images. The invention more particularly relates to a method and apparatus for printing borderless print images.

Background Art

- 10 [0002] Conventional inkjet print engines contain three primary components which are generally organized in series. These components are a platen located in a print zone, a spittoon in which excess print drops are collected, and a service station which receives a print carriage unit and its associated inkjet cartridges for helping to extend the life of the cartridges by wiping and capping them when they are not in use.

- [0003] In a conventional inkjet carriage unit there may be mounted removably therein one or more ink cartridges or print heads. The carriage unit is adapted to sweep the ink cartridges in a path of travel above a medium sheet that is moved in an orthogonal direction to the carriage unit. As the print heads sweep above the medium, they eject droplets of ink downwardly onto the medium sheet which is supported from below by the platen.

- [0004] In order to avoid the smearing of ink on the underside of a medium sheet, the conventional print engine will prevent the ejection of ink onto the leading, trailing, and side edge portions of the medium sheet. In this manner, sheet margins are created on the medium sheet, which in turn protect the upper surface of the supporting platen from the ink droplets being ejected by the print head.

- [0005] While the printing of images with borders has been satisfactory for most applications, with the advent of photo printers and the like there has been a desire to print borderless images.

- [0006] One attempt at seeking to provide a user with border and borderless print images has been to print images on medium stock with perforated tabs. With this arrangement if a user desired a borderless print, the user would merely separate the perforated tab from the remaining portion of the medium stock carrying the print image. In order to avoid tearing the medium stock carrying the print image most users would utilize a trimming device to separate the tab from the stock.

- [0007] While the utilization of perforated medium stock in an inkjet printer may provide borderless print images, the use of such medium stock is expensive and may result in a valuable image being torn when a trimming device is unavailable or not used.

- [0008] Therefore it would be highly desirable to have a new and improved inkjet printer that produces borderless print images without the need of utilizing a special trimming device or perforated medium stock.

35 **Disclosure of the Invention**

- [0009] The present invention solves the problem of borderless printing by providing a new and improved inkjet printer that prints edge to edge prints. The new and improved inkjet printer includes housing for supporting a moveable carriage unit that transports at least one print head cartridge along a rectilinear path of travel between a maintenance area and a printing area. A platen and associated drive mechanism is mounted within a print zone area within the housing. The platen has a floor bounded at its outer periphery by an upstanding wall terminating in a lip that defines a hal-
 40 lowed out support area for receiving a sheet of ink absorbent material. A paired set of spaced apart cockle ribs are disposed on opposite sides of two of the platen walls, a front wall member and a rear wall member that help define the print zone area within the printer. One set of the cockle ribs support from below the front or leading portion of a sheet
 45 of print medium as it passes into the print zone area of the printer. The other set of cockle ribs support from below the rear or trailing portion of the print medium as it is leaving the print zone area. A controller mounted within the housing coordinates the sweeping motion of the carriage unit between the print zone area and the maintenance area with the firing of the inkjet print head cartridge nozzles to overprint beyond the outer peripheral boundary areas of the medium sheet

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Brief Description of Drawings

- [0010] The above mentioned features of this invention and the manner of attaining them will become apparent, and the invention itself will be best understood by reference to the following description of the embodiment of the invention
 55 in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a borderless inkjet printer which is constructed in accordance with the present invention;

FIG. 2 is perspective view of a platen mounted within a print zone area of the inkjet printer of FIG. 1 illustrating its associated upper paper guide and drive mechanism;

FIG. 3 is another perspective view of the platen illustrating it without the associated upper paper guide and drive mechanism of FIG. 2;

5 FIGS. 4A-C illustrate the steps of overprint a sheet of print medium to provide a fish edge to edge image prepared in accordance with the present invention;

FIG. 5 is a diagrammatic top plan view of the platen of FIG. 2, illustrating the sheet of print medium as it passes through the print zone;

10 FIG. 6 is a diagrammatic illustration of a sheet of print medium printed edge to edge in accordance with the method of the present invention; and

FIG. 7 is a diagrammatic view of another borderless printer which is constructed in accordance with the present invention.

Preferred Embodiment of the Present Invention

15 [0011] Referring now to the drawings, and more particularly to FIG. 1 thereof, there is shown a borderless inkjet printer 10 which is constructed in accordance with the present invention. The borderless inkjet printer 10 provides for both bordered and borderless print images on conventional medium sheets without the necessity of utilizing special trimmers or perforated medium stock except for bottom edge portions as will be explained hereinafter in greater detail. In accordance with the novel method of overprinting the boundary edge portions of medium sheets, borderless print images are provided in a fast and convenient manner.

20 [0012] The borderless inkjet printer 10, includes a housing 12 having mounted therein a medium output tray 14 for receiving and temporarily storing individual sheets of medium, such as a medium sheet 16, that has passed through a print zone 18 within the printer 10. As will be explained hereinafter in greater detail, an upper paper guide 28 and associated drive mechanism 20 supports and pulls the medium sheet 16 across the print zone 18. A hollowed platen 30 having a front set 35 of cockle ribs and a rear set 37 of cockle ribs support the medium sheet 16 from below as it travels across the print zone 18.

30 [0013] As best seen in FIG. 2, the platen 30 is mounted within the print zone 18 and has a floor 32 that is bounded at its outer periphery by an upstanding wall 34. The upstanding wall 34 terminates in a lip, indicated generally at 36, that defines a hallowed out support area 38 that is dimensioned for receiving a thick sheet 40 of ink absorbent material. The sheet 40 of ink absorbent material 40 is generally blocked shaped having a height that extends to upper boundary surface area of the wall lip 36. The front set 35 and rear set 37 of cockle ribs extend sufficiently above the lip 36 and the absorbent material 40 to support from below a medium sheet as it passes below a print engine 60 mounted within the housing 12.

35 [0014] The print engine 60 is a conventional inkjet print engine that includes a carriage unit 62 mounted moveable on a slider rod 64. The carriage unit 62 moves along the slider rod 64 under the coordinated control of a controller 66 traveling back and forth on a rectilinear path of travel (P) from a maintenance area, indicated generally at 17 into and out of the print zone area 18. The carriage unit 62 holding one or more print head cartridges, such as the print head cartridges 26-27.

40 [0015] As will be explained hereinafter in greater detail, the controller 66 that is mounted within the housing 12, coordinates the sweeping motion of the carriage unit 62 between the maintenance area 17 and the print area 18 with the firing of the nozzles in the inkjet print head cartridges 26-27 to overprint beyond the outer peripheral boundary areas of the medium sheet 16.

45 [0016] In operation, the print engine 60 has two primary modes of operation: a margin mode and a borderless mode. As the margin mode of operation is conventional and well known to those skilled in the art, the details of the operating steps will not be described hereinafter in greater detail.

50 [0017] Considering now the borderless mode of operation in greater detail with reference to FIGS. 4A-C and FIG. 5, in the borderless mode of operation, the print engine 60 causes a medium sheet, such as the medium sheet 16, to be retrieved from the input tray 13. As best seen in FIG. 6, the medium sheet 16 has outer boundary edges at 42, 44, 46 and 48 and includes a tear off portion 16A that is separable from the remainder of the medium sheet 16 by a tear off perforated line 16B. Thus, when the tear off portion 16A is separated from the sheet 16, the sheet 16 acquires a new boundary edge indicated at 16B.

55 [0018] In order to move the medium sheet 16 from the input tray 13, the sheet 16 is engaged by a medium drive mechanism 20 that pulls the medium sheet 16 into the paper path of the printer 10. The medium drive mechanism 20 directs the medium sheet 16 along a paper path of travel (PP) through the print zone area 18 and into the output tray 14. As the medium sheet 16 passes through the print zone area 18, the controller 66 causes at least one of the print head cartridges 26-27 to over spray the medium sheet 16 along its respective leading edge 42 (FIG. 4A) and side edges 44, 46 (FIG 4B) by about a distance D_1 , where the distance D_1 is about 2 millimeters. As best seen in FIGS. 4C and 6,

a trailing edge portion of the print medium sheet 16 includes the tear off 16A that has a length dimension of about W millimeters. The length W is sufficient to permit the tear portion 16A to be controlled by the drive rollers of the drive mechanism 20. The perforated tear line 16B facilitates printing to the edge of the tear line 16B. The sheet 16 is over-sprayed by about a distance D_1 relative to the edge of the tear line 16B, in order to provide an edge to edge or borderless print 50 (FIG. 6) when the tear off portion 16A is removed from the remaining portion of the print medium sheet. The distance D_1 is about 2 millimeters.

[0019] In order to prevent the underside of the medium sheet 16 from picking up any residual ink, the medium sheet 16 is supported from below by the front and rear sets 35, 37 of cockle ribs which are sufficiently spaced from the ink absorbent sheet 40 to prevent contact there with. In this regard, the over spray of ink droplets from the cartridges 26-27 falls directly onto the ink absorbent sheet 40 and is wicked into its interior and away from its surface. Thus such residual ink accumulated by the sheet 40 is prevented from making contact with the underside of the medium sheet 16.

[0020] Considering now the platen 30 in greater detail with reference to FIG. 2-3 and 5, the platen 30 is mounted adjacent the drive mechanism 20 and a upper paper guide 28 that facilitate the transporting of the print medium sheet 16 into the print zone area 18. As best seen in FIG. 4A, as the print medium sheet 16 approaches the print zone area 18, the front set 35 of cockle ribs engage the leading edge 42 causing it to slide along their front surfaces, such as a front surface 96 and onto the top peak portion of each cockle rib within the set 35. As the drive mechanism continues to advance the sheet 16 overlays the front set 35 of cockle ribs protecting them from any over spray from the print heads 26-27 as the sheet 16 is supported from below. The controller 66 stops the sheet 16 as it travels along the paper path (PP) so that the leading edge of the sheet 16 is positioned to facilitate front and side edge image printing as best seen in FIGS. 4A and 4B. Thereafter, as the sheet 16 is advanced along its path of travel, the sheet arrives at a position as illustrated in FIG. 4C where the rear portion of the sheet 16 is supported from below by the rear set 37 of cockle ribs. The controller 66 stops the sheet 16 at the position illustrated in FIG. 4C for example, so that the rear edge portion of the sheet 16 can be sprayed up to the leading edge of the tear off 16A to provide the edge to edge image 50 once the perforated tear off 16A is separated from the sheet.

[0021] Considering now the front set 35 of cockle ribs in greater detail with reference to FIGS. 2-5, the front set 35 of cockle ribs includes a plurality of equally spaced apart upstanding cockle ribs 84-94. In a like manner, the rear set 37 of cockle ribs includes a plurality of equally spaced apart upstanding cockle ribs 72-82. The front set 35 of cockle ribs 84-94 are diametrically opposite the rear set 37 of cockle ribs 72-82. The distance between the front set 35 and the rear set 37 of cockle ribs is selected so that any type of print medium sheet can be sufficiently supported from below by the rear set 37 to reach the front set 35 of cockle ribs without the leading edge of the sheet 16 making contact with the absorbent material. In a like manner, the distance is further selected so that the trailing edge of the print medium sheet does not make contact with the absorbent material 40 after it is no longer supported by the rear set of cockle ribs 84-94. While this is the preferred configuration for the sets of cockle ribs, those skilled in the art will understand that other configurations are contemplated within the true scope of the present invention. Thus for example, the cockle ribs may be unequally spaced in a given set, such as in set 35 or alternately, the cockle ribs in the respective front and rear sets 35, 37 may be offset from one another.

[0022] Considering now the cockle ribs 72-82 and 84-94 in greater detail with reference to FIGS. 2 and 4, the cockle ribs 72-82 and 84-94 are substantially identical to one another so only cockle rib 94 will be described hereinafter in greater detail. In this regard, the cockle rib 94 is integrally connected to the upstanding wall 34 and extends upwardly therefrom a sufficient distance to prevent the print medium sheet 16 from making contact with the absorbent block 40. The cockle rib 94 has a block like base and a tapered top 96 that slants upwardly in a direction opposite of the path of travel followed by the print medium as it enters the print zone 18. The upward slanting of the rib 94 is an important feature as it facilitates the lifting of the leading edge of the sheet 16 onto the top peak of the rib so that the sheet is disposed at a maximum distance from the absorbent material 40 relative to the over all height of the rib 94.

Table I

Material Type	Thickness	Number of Sheets In Life Cycle	Number Printed Before Failure	Type of Observable Failure (Identified Cause of Failure)
Sample #1	Unknown	6000	4000	Small specks of ink stuck to backside of sheet. Specks can be easily brushed off without smearing the underside of the medium. (Whiskers of ink build up from top surface of absorbent material and break off sticking to underside of medium.)
Cotton Fiber Absorbent				
Ahlstrom Grade: 320 100% cotton fiber				
Basis Weight: 720g/m ²				
Flow Rate: 220 ml/min				
Wet Burst: 20 in H ₂ O				
Capillary Rise: 79 mm in one minute				
Sample #2	Unknown	6000	4500	Small amount of ink transferred to the backside of the medium in the shape of small spots. (Ink build up from surface of the absorbent material is sufficient to make contact with the underside of the medium.)
POREX Technologies X-4894 medium sheet 45-90μ. without surfactant				
Sample #3	Unknown	6000	5000	Small amount of ink transferred to the backside of the medium in the shape of a line. (Ink build up from the surface of the absorbent material is sufficient to make contact with the underside thereof.)
Same as Sample #2				

[0023] To verify the reliability of the printer 10, a series of simultaneous test were conducted printing the same set of print images but using different type of ink absorbent materials and different thickness of material. Table I summarizes the results of the various tests.

[0024] Referring now to FIG. 7 there is shown a borderless inkjet printer 100 which is constructed in accordance with the present invention. The borderless inkjet printer 100 is substantially similar to the printer 10 except that it provides for both bordered and borderless print images on conventional medium sheets without the necessity of utilizing special sheet cutters or perforated medium stock. In short, no trailing edge tear off medium sheet is required.

[0025] In order to accomplish edge to edge printing the printer 100 further includes a front set of motor driven drive rollers 102 that help move a print medium sheet 116 along a path of travel from a print zone 118 into an output tray, such as the output tray 14.

[0026] The operation of the printer 100 is substantially similar to printer 10 except the drive rollers 102 advance the sheet 116 into the print zone 118 a sufficient distance to permit a trailing edge 148 of the sheet to be oversprayed by the inkjet nozzles 127 of the print head 126. As best seen in FIG. 7, the nozzle 127 oversprays the trailing edge 148 by about a distance d, where d is about 2 millimeters. It should be understood by those skilled in the art that the distance d can be less or greater than 2 millimeters depending upon the size and paper weight of the particular print medium handled by the printer 100.

[0027] While particular embodiments of the present invention has been disclosed, it is to be understood that various different modifications are possible and are contemplated within the true spirit and scope of the appended claims. Thus,

for example, the cockle ribs could be more closely spaced apart in the lateral direction. Alternately, the sets of cockle ribs could extend upwardly from the floor of the platen to be more closely spaced apart in their other direction. In this configuration, rib extending holes would be necessary in the absorbent material. Finally, a combination of cockle ribs could be provided where some extend from the wall lip while others extend from the platen floor. In any event, it should be recognized by those skilled in the art that placement of the cockle ribs on the floor area necessarily would limit the available over spray area that would be required to prevent the over spray from contaminating the uncovered ribs. From the foregoing, there is no intention, therefore, of limitation to the exact abstract or disclosure herein presented.

Claims

1. A borderless printer (10) having a print zone(18) for facilitating the ejecting of ink droplets onto a medium sheet (16), comprising:

a platen (30) disposed within said print zone (18), said platen (30) having an opening defined by a set of upstanding wall members (34) terminating in a lip (36);
 a front set of cockle ribs (35) and a rear set of cockle ribs (37) each extending upwardly from said lip (36) for supporting from below the medium sheet as it passes over said platen (30); and;
 an ink absorbent member (40) disposed below said lip (36) within said opening for absorbing an over the edge ejection of ink droplets directed at the peripheral edge of the medium sheet (16) as it passes through the print zone (18) to facilitate the formation of a borderless print.

2. A borderless printer (10) according to claim 1, wherein said front set of cockle ribs (35) includes a plurality of upstanding spaced apart cockle ribs (84-94) extending upwardly from said lip (36) a sufficient distance to substantially prevent a leading edge (42) of the medium sheet (16) from making contact with said ink absorbent member (40) as the medium sheet (16) travels across the print zone (18).

3. A borderless printer (10) according to claim 1, wherein said rear set of cockle ribs (37) includes a plurality of upstanding spaced apart cockle ribs (72-82) extending upwardly from said lip (36) a sufficient distance to substantially prevent a rear portion (16) of the medium sheet (16) from making contact with said ink absorbent member (40) as the medium sheet (16) travels across the print zone (18).

4. A borderless printer (10) according to claim 2, wherein said plurality of upstanding cockle ribs (84-94) are equally spaced apart.

5. A borderless printer (10) according to claim 2, wherein said plurality of upstanding cockle ribs (84-94) are unequally spaced apart.

6. A borderless printer (10) according to claim 3, wherein said plurality of upstanding cockle ribs (72-82) are equally spaced apart.

7. A borderless printer (10) according to claim 3, wherein said plurality of upstanding cockle ribs (72-82) are unequally spaced apart.

8. A borderless printer (10) according to claim 1, wherein said set of front cockle ribs and said set of rear cockle ribs are disposed spaced apart and diametrically opposite from one another.

9. A borderless printer (10) according to claim 1, wherein said front set of cockle ribs (84-94) and said rear cockle set of ribs (72-82) each include an upwardly tapered top portion for facilitating the lifting of the medium sheet (16) to disposed the medium sheet (16) at a maximum distance from the absorbent material (40) as the sheet (16) travels across the print zone (18).

10. A method of borderless printing, comprising:

moving a medium sheet (16) across a print zone (18) having a platen (30) disposed therewithin, said platen (30) having an opening defined by a set of upstanding wall members (34) terminating in a lip (36);
 lifting said sheet (16) from beneath a sufficient distance above said lip (36) to substantially space said sheet (16) from an ink absorbent member (40) disposed below said lip (36) and within said opening for absorbing an over the edge ejection of ink droplets directed at peripheral edge portions of the medium sheet (16) as it

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passes through the print zone (18); and
ejecting a plurality of ink droplets at the peripheral edge portions (42, 44, 46, 48) of the medium sheet (16) as
it passes through the print zone (18) to facilitate the formation of a borderless print.

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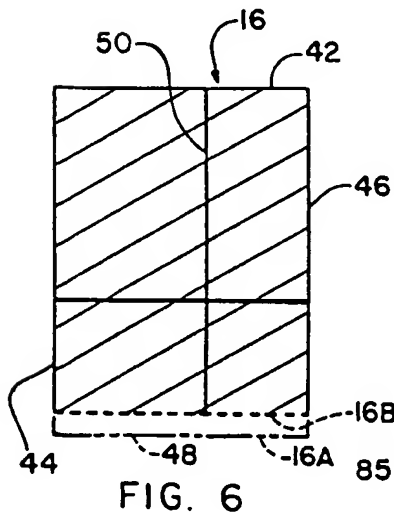
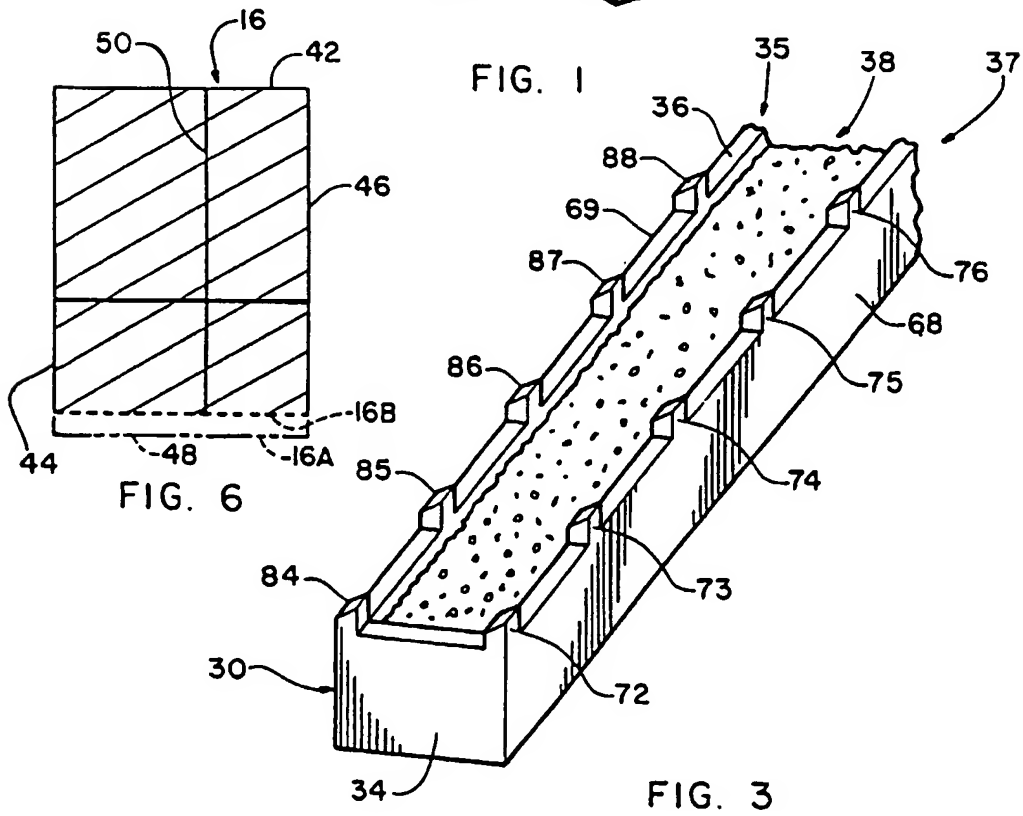
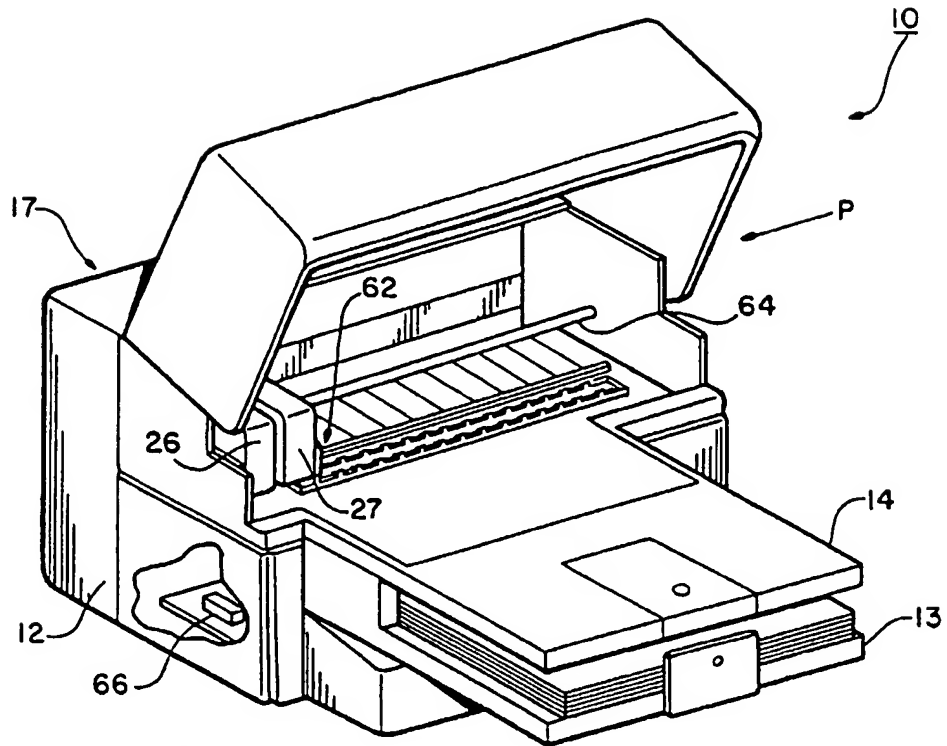
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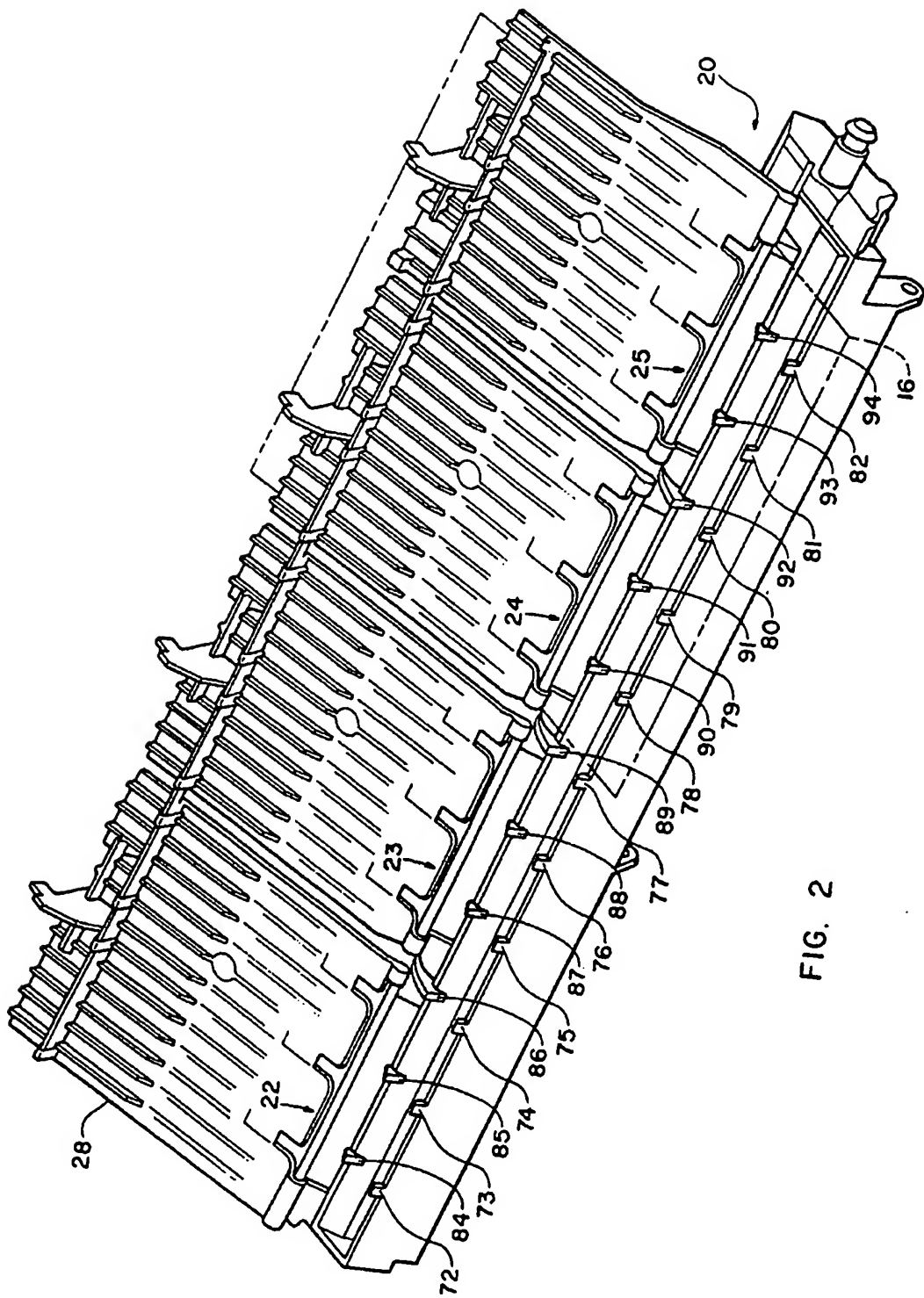


FIG. 2

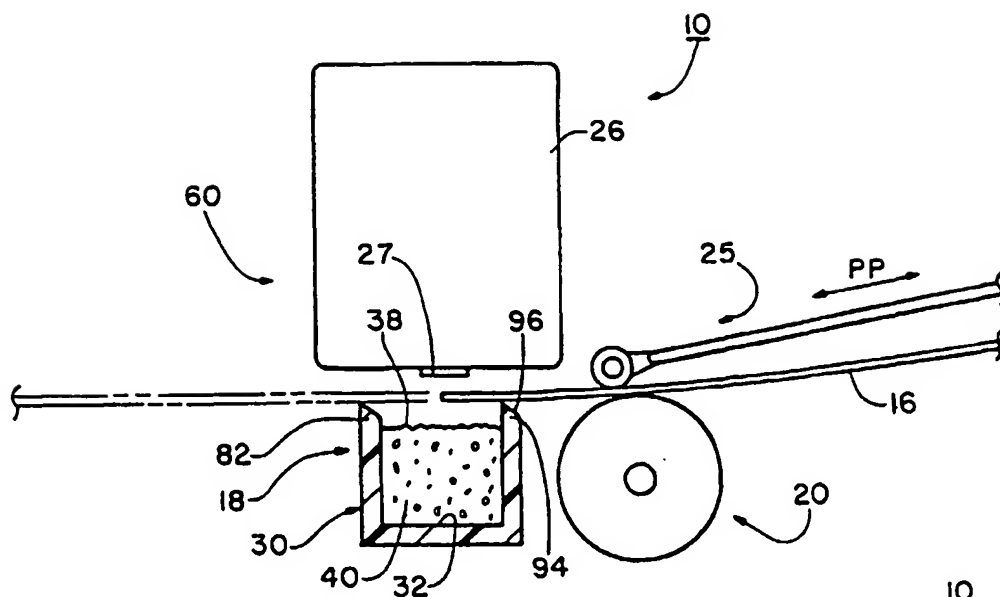


FIG. 4B

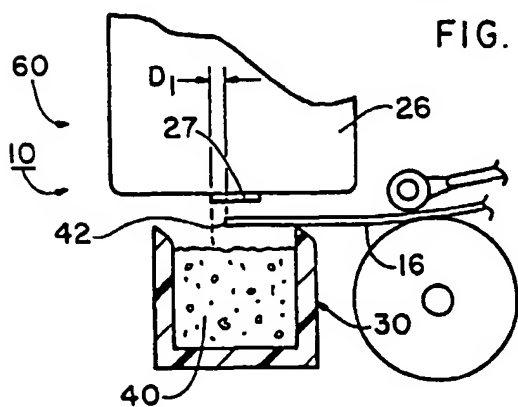


FIG. 4A

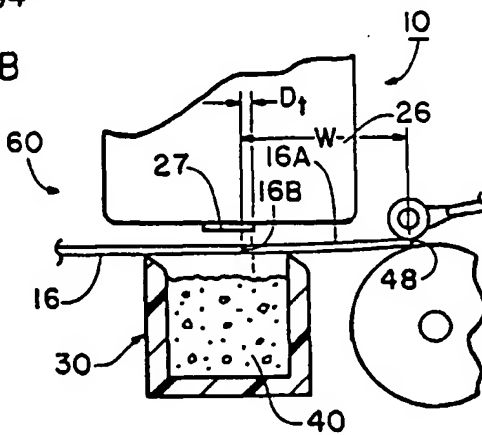


FIG. 4C

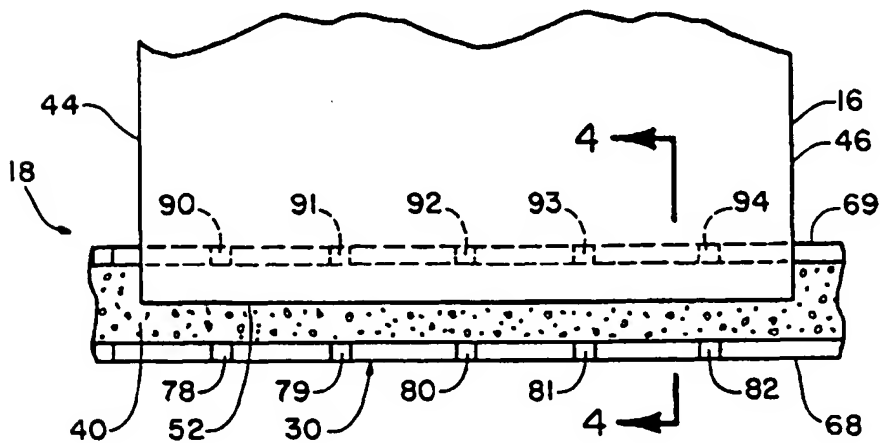


FIG. 5

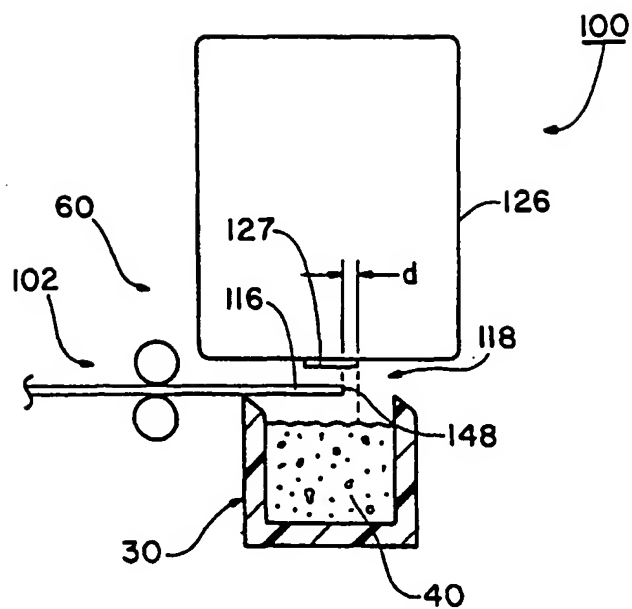


FIG. 7